461. INF
427.8

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

not in
db

PRELIMINARY REPORT

NORTHFORK BURN STUDY

SIERRA NATIONAL FOREST

by

J. M. MILLER
Entomologist

U. S. Bureau of Entomology

SB
Annex
SB
763
.C2 S6
1927c

Box 3010
Stanford University
May 23, 1927

GOVERNMENT PRINTING OFFICE

PRELIMINARY REPORT

NORTHFORK BURN STUDY

SIERRA NATIONAL FOREST

by

J. M. MILLER,
Entomologist

U. S. Bureau of Entomology

Box 3010
Stanford University
May 23, 1927

v

C O N T E N T S

Page

Introduction - 1

Conditions of Northfork Fire- - - - - - - - - - - - - - - - - 2

Plans for Study of Subsequent Infestation- - - - - - - - - - 2

Classification of Fire Damage - - - - - - - - - - - - - - - - 3

Loss Estimates - 4

Insect Losses Within the Burned Area- - - - - - - - - - - - - 5

Effect of Fire Injury Upon Growth and Susceptibility of Trees to Insect Attack- - - - - - - - - - - - - - - - - - 6

Character of Losses on Sample Plots - - - - - - - - - - - - - 8

Selection of Fire-Injured Trees by Insects - - - - - - - - - 8

Development of Western Pine Beetle Broods in Fire-Injured Trees - 9

Appendix

Sample Plot Data -10

Sample Strip Data - 16

Photos Illustrating Fire Damage-

PRELIMINARY REPORT
NORTHFORK BURN STUDY

Introduction

The Northfork fire started June 22, 1924, and burned over 5460 acres along the western front of the Sierra National Forest. This burn was characteristic of the more severe fires in the lower yellow pine type of this region. It was in fact one of a series of similar fires during the past twenty years which have brought about an obvious change in the forest cover. Coming in from brush areas to the west, fires of this character have attacked the first fringe of timber with unusual severity. Between Bass Lake and the San Joaquin River much of the yellow pine type, forming inferior stands between elevations of 2000 and 3500 feet, has disappeared. Only in the more protected sites, as along stream beds and on favored slopes, are any appreciable areas left of the former stands of growingtimber. On the poorer sites the scars of these burns restock slowly if at all, and brush soon comes in as the subsequent type.

The Northfork burn was the latest as well as the largest of successive steps in this recession of type in this locality. On about 7% of the area the entire cover was destroyed by the first sweep of the fire. During the season of 1924 very few trees died except those that had been immediately killed by the heat. But during the following season of 1925 thousands of trees died, the majority of which had put out new needle growth. This subsequent dying of trees which had survived the fire greatly extended the area of heavy damage, and it now seems apparent that at least 25% of the burn will pass over into barren or brush type. At several points the forest front has been pushed back to the 5000-foot contour, where under natural protecting barriers and on favorable sites the pine type seems capable of maintaining itself.

Barkbeetles along with fires have been a factor in bringing about this perceptible change of conditions. Studies to follow up the extent to which insects have contributed to the total loss following the fire have been under way on the Northfork burn since 1924. The purpose of this report is to assemble some of the data now at hand as a result ofthis study in order to facilitate further work. Additional examinations will be made during the 1927 field season, and the final analysis of the project will have to await the completion of this work.

Conditions of Northfork Fire

The main area covered by the fire consists of the western slope of Peckinpah Mountain (see Photo No.1). Elevations range from 2600 feet at Southfork Creek to 5500 at the summit of the ridge. The general exposure is west and southwest. No fires had previously burned over the general area for at least thirty years, so that a heavy accumulation of brush was mixed with yellow pine stands of varying ages. As the entire tract sloped abruptly to the west, crown damage was inevitable in the case of a fire burning from bottom to top of this ridge.

When on the morning of June 24 a fire starting from a residence at Northfork spread through grass and brush cover, jumped Southfork Creek and started up the slopes of Peckinpah Mountain, with low atmospheric humidity and a light wind from the southwest, conditions were right for a fire of the most serious character. The only feasible plan of control consisted in checking the head of the fire at the top of the ridge and limiting its lateral spread along the flanks of the mountain. This was accomplished during the night of June 24, but permanent control was not established until June 27.

The character of the fire and the resultant damage within the burn varied greatly. The irregular, broken topography, giving a variety of slopes, together with varying cover types and time of fire, resulted in a very spotted distribution of the types of fire damage. These varied all the way from a very light ground fire to one in which practically all cover was consumed, leaving only the charred boles of the larger trees.

Plans for Study of Subsequent Infestation

It was early realized that this area would be suitable for a study of the character of insect infestations following the fire. Both the burn and much of the surrounding area were included in the San Joaquin Project, on which various experimental insect-control studies had been under way. The Bureau of Entomology had been making an annual cruise of barkbeetle losses on this project area since 1920. Previous studies by both the Bureau of Entomology and the Forest Service indicated that the course of the infestation would be materially changed, and the effects of the control work probably nullified, as a result of the fire. A study of the effects of the fire appeared to be a logical continuation of the former project.

On August 16 to 18 three sample plots were laid out in the burn by P.C. Craighead, H.E. Burke, H.L. Person and J.M. Miller. The object of these plots, which consisted of 100 tagged trees each, was to determine the susceptibility to subsequent insect attack by trees of different degrees of fire injury.

In July, 1925, a quantitative survey of fire and insect damage within the burn was started by Mr. Person. Two and three-tenths miles of sample strips, totaling 36.6 acres, were run, on which all trees were marked according to class of fire injury, and a record made of all insect attacks. In addition to this a 100 per cent cruise was made of the entire burn area in September 1925. In this survey the area was mapped according to type of burn and all insect-attacked trees marked and numbered.

The project still requires subsequent examinations of the sample plots to determine the ultimate survival of trees, and another cruise of the area to complete the record of the 1925 and 1926 insect loss; the latter will be finished in 1927.

Classification of Fire Damage

A standard classification of the varying degrees of fire injury was essential as a basis upon which to study the relation of this injury to insect attacks. This classification must take into account both the injury to the individual tree as shown by the degree of defoliation, basal scars etc., and the extent of injury to the general forest cover as indicated by the percentage of stand injured or killed, usually defined as a light, medium or severe type of burn.

The following classification was adopted to express extent of injury to individual trees:

1. Classes of Fire Injury

I	No visible fire injury
II	Up to 25% of crown defoliated
III	25 to 50% " "
IV	50 to 75% " "
V	75 " 100% " " but with terminal buds and cambium green
VI	100% defoliation, cambium severely injured, terminal buds killed

It was necessary to group trees in this classification on the evidence visible from the ground. The distinction between Classes V and VI was sometimes difficult to make, asthe heat of a crown fire sometimes kills the cambium on the under side of limbs and twigs without injuring that nearthe base of the main trunk. Trees entirely scorched may still retain green buds near the top which cannot be seen.

2. Types of Burn

1. No fire injury; all trees in Class I (only a few small patches of this type occurred within the boundaries of the burn, so that the area was negligible)

2. Light ground fire; practically no standing trees killed; damage represented by Classes II and III

3. Medium fire damage; less than 25% of stand killed; damage represented by Classes IV and V, which compose more than 50% of stand

4. Severe crown fire; more than 50% of stand in Classes V and VI

Loss Estimate Obtained by Quantitative Survey

The estimates for the burn (based upon sample strip data and the insect survey for the entire area) given in the tables attached to this report stand as follows:

Acreage - - Type I - -	0
II- -	3790
III - -	1300
IV- -	370
Total - -	5460
Average stand B.F. per acre (yellow pine)- -	3500
Volume in B.F. for entire burn - - -	19,110,000

Estimated Volume According to Classes of Fire Injury

	No.Trees	%	Av.Vol.	Total Volume	% Volume
Class I	2,883	14.1	1140	3,286,920	17.2
II	5,898	28.3	1460	8,465,730	44.3
III	3,268	16.0	912	2,981,160	15.6
IV	3,509	17.1	795	2,790,060	14.6
V	2,452	14.5	324	974,610	5.1
VI	2,011	10.0	304	611,520	3.2
	20,021	100.0		19,110,000	100.0

In Ranger Wofford's fire report of July 7, 1924, the loss in merchantable timber was placed at 1,790,000, which corresponds fairly closely to the total of 1,586,000 board feet included in Classes V and VI. The above figures apply entirely to standing trees.

The fire was of such a character that the loss from trees burned down by fire in basal scars was very light. No loss from this source was encountered on the sample plots, and very few such trees were noted in the general cruise of the area.

Insect Losses Within the Burned Area

Within a month after the fire practically all trees in Class VI were heavily attacked by cambium-feeding insects, mainly flathead and roundhead borers. The same insects appeared wherever fire had extended basal scars in living trees or where the cambium on one side of the tree had been deadened. These insects, however, are seldom capable of extending their work into living cambium, their importance being largely secondary. Although records of their occurrence were kept on the sample plots and strips, this phase of the study was merely incidental to the more important tree-killing barkbeetles.

The western pine beetles in yellow pine proved to be the most important agent in the killing of fire-injured or weakened trees. The mountain pine beetle was also present to a considerable extent in the sugar pine, but neither this host tree nor the insect entered to any degree into the loss of trees subsequent to the fire. The record of losses, both before and after the fire, consists almost entirely of yellow pine attacked by the western pine beetle and insects of secondary importance associated with this attack.

The volume of yellow pine timber killed by beetles within the area of the burn during the period from 1919 to 1923 was marked annually during the course of the San Joaquin Project.

Yellow Pine Loss Prior to Fire

Year	No.Trees	Vol.B.F.	Loss B.F.per Acre
1919	213	136,120	24
1920	67	100,410	18
1921	61	86,640	16
1922	113	146,670	27
1923	34	79,780	14

The record of timber killed subsequent to the fire is now complete for the 1924 season. As the cruise was made during September 1925, not all the loss for that season was then evident. This record will be completed with a cruise to be made in May 1927 which will also include the loss for 1926, giving figures for three consecutive seasons following the fire.

Yellow Pine Loss Marked Up to October 1, 1925
According to Type of Burn

Year		Acreage	No. Trees	Volume	Loss per Acre
1924	Site II	3790	184	262,800	69
	III	1300	357	324,200	249
	IV	370	101	79,810	216
	Total	5460	642	666,810	534
1925	II	3790	1109	1,209,640	319
	III	1300	2339	2,102,160	1617
	IV	370	364	289,380	782
	Total	5460	3812	3,601,180	2718

The total loss marked up to this time for the two seasons subsequent to the fire totaled 4,267,990 board feet on nearly 15% of the total stand.

This insect loss was distributed among the various classes of fire-injured trees as follows:

	1924			1925		
	No. Trs.	Volume	Av. Vol. per Tr.	No. Trs.	Volume	Av. Vol. per Tr.
Class I	0	0	0	20	23,560	1178
II	45	32,260	73	543	511,920	943
III	136	118,310	869	1191	1,187,700	997
IV	302	336,700	1115	1803	1,631,200	904
V	159	179,140	1127	255	246,800	968
Total	642	666,810	1038	3812	3,601,180	944

Effect of Fire Injury Upon Growth and Susceptibility of Trees to Insect Attack

As previous studies by Person have shown that the western pine beetle consistently prefers slow-growing trees in its attacks, the matter of growth rate in the fire-injured trees becomes pertinent to this study. The heavy concentration of western pine beetle infestation in burns of this character may be due to the slowing down or complete checking of growth as a result of defoliation and other injury by fire, rather than the attraction due to heat, smoke or scorching of the trees.

This phase of the project has been taken up on the sample plots that were established in August, soon after the fire. Plot 1 includes types of burn III and IV, or heavy fire damage; Plot 2 includes type II or light damage, while Plot 3 represents a mixed type of all phases represented on the other two plots. In order to obtain preliminary data on the amount of growth recovery following the fire, cores were taken from all trees on these plots on October 10, 1926, and these were used as a basis for measurements of the 1924, 1925 and 1926 growth rings. A comparison with growth in trees on an area not affected by the fire was made by measurements from trees on the Cascadel Unit, an area immediately adjoining the sample plots of the burn and presenting the same site and type conditions.

At the time of the fire the summer wood for 1924 was partially formed, so that the effect of the fire registered in the late wood of that season. 1924 was exceptionally dry, so that a light ring was formed for that year. In an examination of the sample plots in July 1925, Dr. Craighead pointed out that in a number of Class IV and Class V trees no perceptible ring had been formed since the spring of 1924. This point naturally could not be determined in the cores without an identification of the preceding rings. All trees on the plots were originally marked by blazing so as to leave a scar on the cambium. The formation of new wood alongside this scar, which in all live trees starts as a healing callus, gave a definite point at which the summer wood of 1924 could be identified. Quite often distinct rings could be found about the blaze, while no trace of a ring beyond the 1924 spring wood was discernible elsewhere on the bole (see Photos 9 and 10).

The number of trees which failed to make any appreciable increment following the fire are shown in the following table:

Per Cent of Trees Showing No Growth After Fire

	Fire Classes				
	I	II	III	IV	V
Plot 1	0	0	0	33%	98%
2	0	0	0	0	0
3	0	0	8.3	0	72
For all Plots	0	0	3.1	15.5	83.2

In Class V, 3 trees showing no growth rate still survive out of 71 on Plot 1, while on Plot 3, 2 trees out of 33 still survive. This class was the one most preferred by the western pine beetle, 48% of the trees being attacked, as shown in Table No. 3.

The effect of the fire, as registered by average annual growth rate, is shown in Tables 5 and 6, and the same data are diagrammed in Charts 1, 2 and 3. These charts compare the loss of increment, both according to fire classes and for the plots as a whole.

The fact that the average growth held up much better for Classes IV and V on Plot 2 than on the other two plots was probably due to the lessened intensity of the heat. Although the foliage was entirely scorched on a number of trees on this plot so that there was an apparently complete defoliation, the heat was not sufficient to kill the cambium on the lower sides of the limbs or the terminal buds. On Plots 1 and 3 the severe heat had apparently killed the cambium of the twigs as well as scorched the foliage, which should explain the difference noted between these two sample plots in regard to growth and mortality.

Some attention was also given to growth rate in the insect-killed trees marked on the sample strips. This was determined by chipping the tree and examining the rings with a hand lens. On this basis these trees were grouped as follows:

	No.Trs.	Per cent
No perceptible growth since fire - - - - -	74 - -	-62.6
Slight " " - - - - - -	39- - -	33.2
Fair " " - - - - -	5 - -	- 4.2
Totals-	118- -	-100.

Character of Losses on Sample Plots

The character of the losses occurring on the three sample plots is shown in Tables 1 and 2. The plots compared as follows in the examination made in October 1926:

Plot No.	No.Trees Dead	No.Trees Alive	% Survival
1	87	13	13
2	1	99	99
3	44	56	56

The per cent of survival in the various classes of injury stands as follows:

Class	No.Trees Dead	No.Trees Alive	% Survival
I	-	27	100
II	-	61	100
III	1	97	97
IV	16	29	69
V	105	20	16

By far the greater part of this loss occurred in 1925, when a conspicuous concentration of the western pine beetle occurred throughout the burn in Class IV and Class V trees. These attacks continued into 1926, when a high percentage of the attacks occurred in Class IV trees, the greater proportion of which were apparently on the road to recovery.

Selection of Trees by Insects

A summary of trees killed by insect attack is shown for the sample plots in Tables 3 and 4 and for the sample strips in Tables 9, 10 and 11.

On the sample plots approximately 40 per cent of all trees were attacked by insects, as against 20 per cent on the strips.

A marked preference was shown for trees in Class V by the western pine beetle, 48 per cent of this class being attacked on the sample plots and 35 per cent on the strips.

As many living trees have not recovered from the effects of the fire, these data are of a preliminary character and will be supplemented by later examinations.

Development of Western Pine Beetle Broods in Fire-Injured Trees

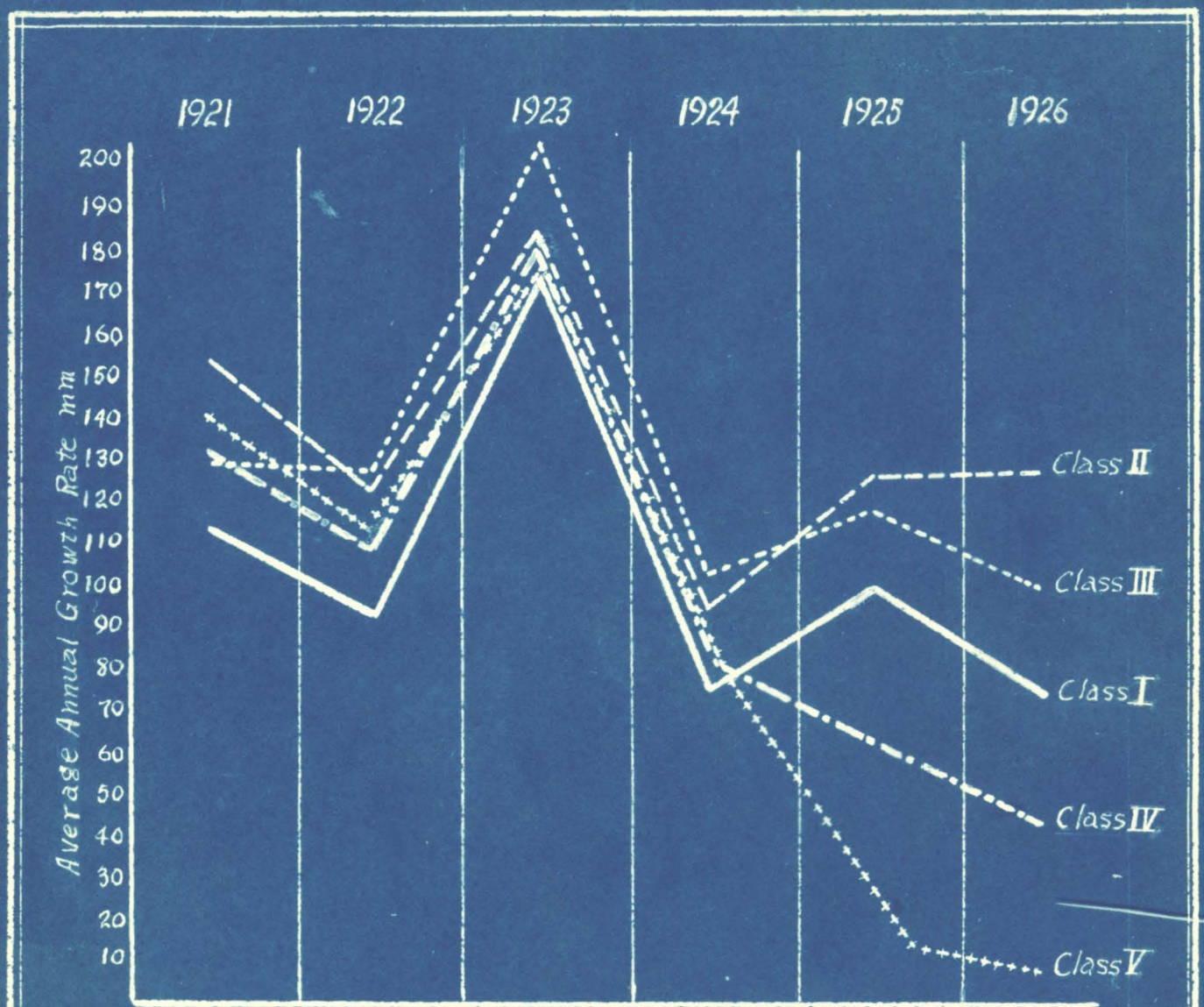
During the winter of 1925-26 an effort was made to determine whether or not western pine beetle broods were developing successfully in the fire-injured trees. Approximately 20 trees were selected from each class of fire injury. These were felled and two square feet of bark removed at ten-foot intervals along the trunk for the infested length. Entrance holes, representing the beetles attacking the tree, and exit holes, representing the beetles emerging, were counted for each section removed. All trees examined were attacked in the summer of 1925, and emergence was complete before winter. The following table summarizes these counts:

Class	No.Trs.	Av.D.B.H. inches	Av.Inf. Length	Av.No.Beetles Att.per sq.ft.	Av.No.Beetles Emrg.per sq.ft.
II	19	24	58	21	36.2
III	20	26	67	18	6.7
IV	20	24	51	10.3	17.8
V	19	22	35	7.6	16
VI	20	24	32	6.5	20.6

The rate of increase is below normal in all classes except VI, while in Class III the mortality among the broods was so high as to result in a decided decrease. However, the mortality observed in the individual trees was so varied and irregular that the above counts seem to have little significance. It is apparent that in certain trees conditions of the inner bark were unfavorable to brood development, but this does not seem to have any consistent relation to the class of fire injury.

The most consistent tendency shown by these brood counts is the gradual reduction in numbers of beetles attacking per square foot of bark as the amount of fire injury increased. In Class II the attack averaged 21 beetles per square foot, while in Class VI the average was 6.5.

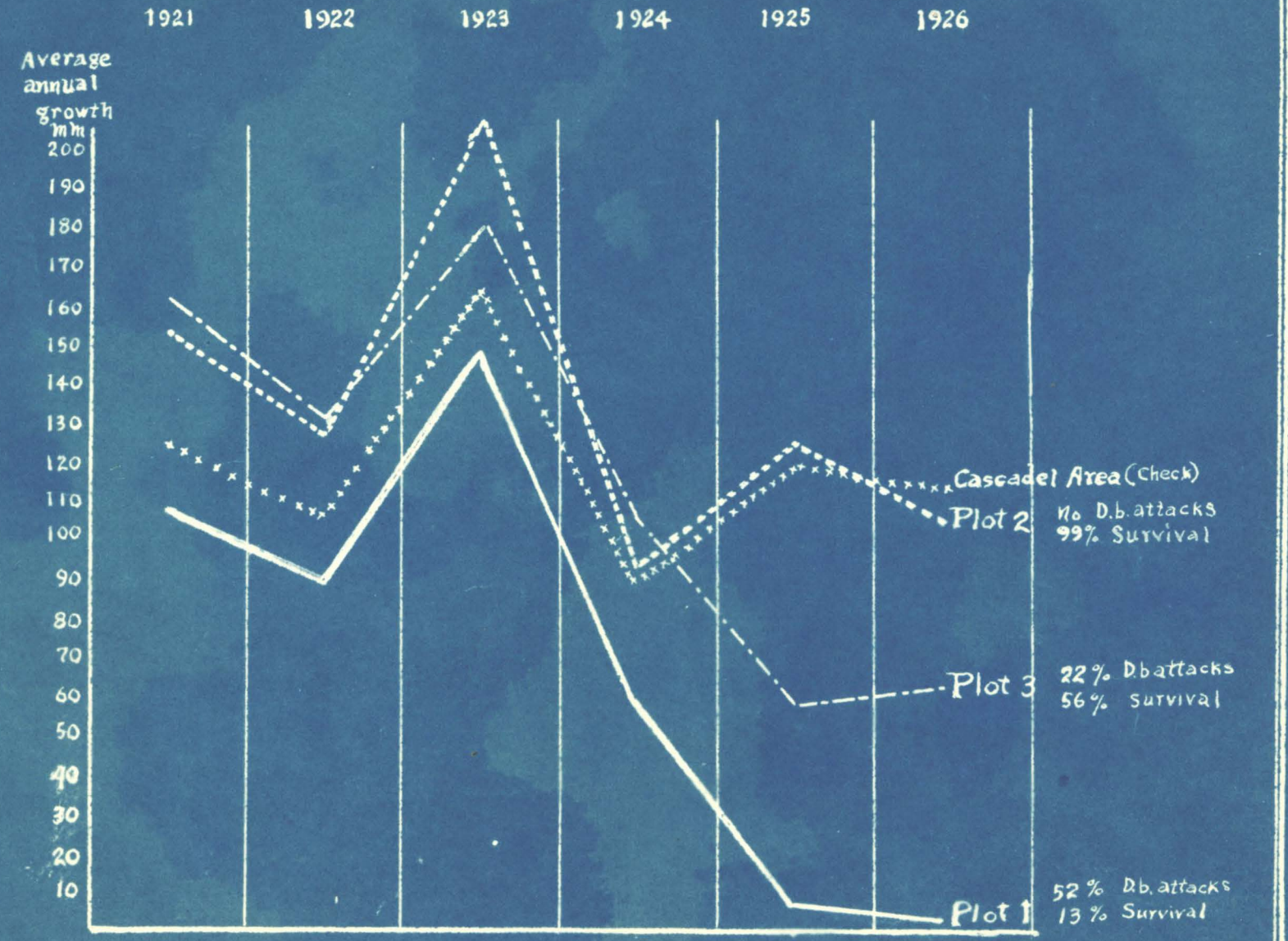
This difference is apparently due to lack of resistance to attack on the part of the fire-injured trees. In trees with normal growth conditions, the beetles must attack in sufficient numbers to break down resistance of the sap flow before the broods can develop in the cambium; while in trees where growth has been checked by fire injury the attack of a relatively small number of beetles is followed by death of the trees and successful development of the new broods. The relation of beetle attacks to the class of fire injury is in line with the reduction of growth rate in the same classes.



COMPARISON OF AVERAGE ANNUAL GROWTH RATE BY FIRE INJURY CLASSES ON ALL SAMPLE PLOTS

CHART 1

CHART 2



AVERAGE ANNUAL GROWTH FOR ALL CLASSES OF FIRE INJURY ON SAMPLE PLOTS IN BURN AND ON UNBURNED CASCADEL AREA

AVERAGE ANNUAL GROWTH RATE FOR EACH CLASS OF FIRE INJURY ON SAMPLE PLOTS

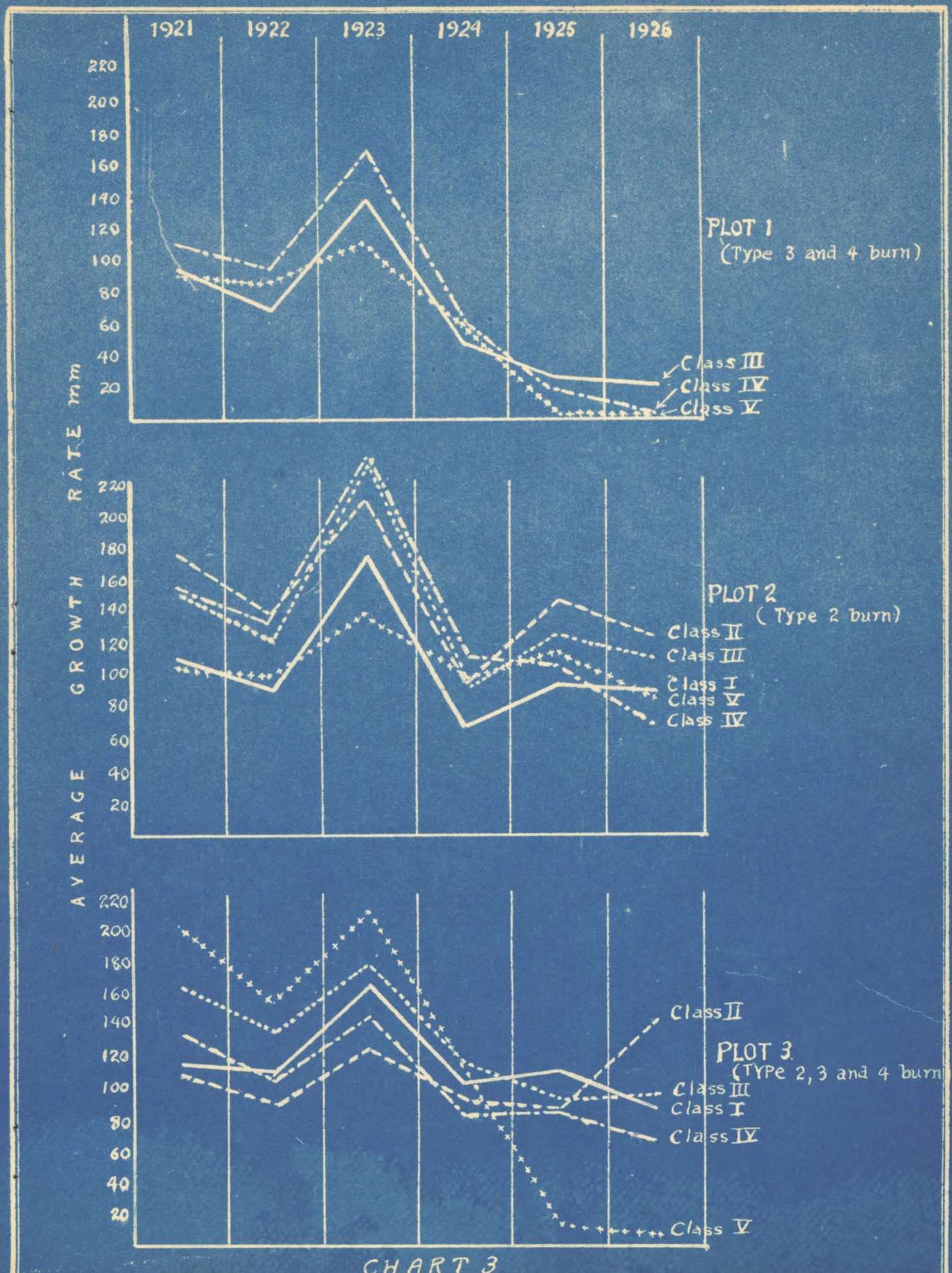


CHART 3

SAMPLE PLOT DATA

Three sample plots were established, August 16 to 18, for the purpose of following up the susceptibility to insect attack of trees showing different degrees of fire injury.

The descriptions of these plots are as follows:

Plot No.1 - Inspector Trail

Location Beginning near corner of Sections 8,9,16 and 17, T 7 S, R 23 E, follows the old Inspector Trail west for approximately 30 chains; 4 acres, 100 tagged trees.

Description Represented by Burn Types III and IV. This plot was burned over during the afternoon by a crown fire of intense heat.

Plot No.2 - Pine Flat

Location On the old Mission Hill Road in Sec. 17, approximately 20 chains west and 25 chains south of corner to Secs. 8,9,16 and 17; 3 acres, 100 tagged trees.

Description Represented by Burn Type II. This plot was burned over at night by backfire; complete scorching of needles only on small trees; larger trees, lower limbs only scorched.

Plot No.3 Peckinpah Mill

Location Approximately 20 chains east of ¼ corner between sections 4 and 5, T 8S, R 23 E; just below brow of hill SW of old Peckinpah Mill; 4 acres, 100 tagged trees.

Description Represented by Burn Types II, III and IV; the burn type on this plot was mixed, including all phases found on Plots 1 and 2.

DATES OF EXAMINATIONS ON SAMPLE PLOTS

	Plot 1	Plot 2	Plot 3
Aug. 16,17,18, 1924	Marked	Marked	
Oct. 17-23, 1924	Reexamined	Reexamined	Marked
July 9-11, 1925	"	"	Reexamined
July 5, 6, 1926	"	"	"
Oct. 7-10, 1926	"	"	"
	Cores taken	Cores taken	Cores taken

Table No. 1

SUMMARY OF NUMBER OF TREES KILLED AND SURVIVING ON SAMPLE PLOTS

	Classes of Fire Injury						
	I	II	III	IV	V	VI	Total All Classes
Plot No.1 INSPECTOR TRAIL							
No. Trees			1	21	72	6	100
Average D.B.H.			38	27	19.4	22.8	21.3
No. trees dying subsequent to fire - 1924					11	6	17
1925				1	40		41
1926				11	18		29
Totals:				12	69	6	87
No. trees alive, October, 1926			1	9	3		13
Per cent of survival			100	43	4	0	13
Plot No.2 PINE FLAT							
No. trees	21	42	19	11	7		100
Average D.B.H.	22.6	24.4	20.2	12.8	9.7		20.94
No. trees dying subsequent to fire - 1924							
1925				1			1
1926							
Totals:				1			1
No. trees alive, October, 1926	21	42	19	10	7		99
Per cent of survival	100	100	100	90	100		99
Plot No.3 PECKINPAH MILL							
No. trees	6	19	12	13	46	4	100
Average D.B.H.	28.6	32.8	26.5	26.7	30.3	26.5	29.6
No. trees dying subsequent to fire - 1924						4	4
1925					36		36
1926			1	3			4
Totals:			1	3	36		44
No. trees alive, October, 1926	6	19	11	10	10	0	56
Per cent of survival	100	100	91.7	77	27	0	56

Table No. 2

TOTALS BY CLASSES OF FIRE INJURY FOR ALL PLOTS

	I	II	III	IV	V	VI	Total
No. trees	27	61	32	45	125	10	300
Average D.B.H. (inches)	23.9	27	23.1	23.3	22.8	24.2	23.6
No. trees dying subsequent to fire - - - 1924					11	10	21
1925				2	76		78
1926			1	14	18		33
Totals			1	16	105	10	132
No. trees alive October 1926	27	61	31	29	20	0	168
Per cent of survival	100	100	97	69	16	0	52

Table No. 3

SUMMARY OF WESTERN PINE BEETLE ATTACKS IN CLASSES OF FIRE INJURY

	I	II	III	IV	V	VI	Total
Plot No. 1 - - - 1924				1	14	2	
1925				3	28		
1926				5			
Totals				9	42	2	53
Plot No. 2 - - - 1924							
1925							
1926							
Totals							0
Plot No. 3 - - - 1924						1	
1925			1		18		
1926				2			
Totals			1	2	18	1	22
Grand Totals			1	11	60	3	75
Per cent of Total Attacked by Beetles			3%	24%	48%	33%	25%

Table No. 4

SUMMARY ALL PLOTS
TREES ATTACKED AND SURVIVING TO OCTOBER 1926

No. trees killed by fire - Class VI	10	3.3%
" attacked by D.brevicomis	75	25.
" " other insects, mainly flat-head and round-head borers and D.valens; primary attack doubtful	47	15.7
" surviving	168	56.
Total	300	100%

Table No. 5

SUMMARY OF TOTAL AND AVERAGE ANNUAL GROWTH IN MILLIMETERS FOR EACH CLASS OF FIRE INJURY, 1921 to 1926 INCLUSIVE

	No. trees	1921	1922	1923	1924	1925	1926
Class I							
Plot I							
II	17	1950	1561	3033	1089	1646	1604
III	6	716	705	983	612	673	542
	23	2666	2266	4016	1701	2319	2146
Av.		116	94	174	74	100	84
Class II							
Plot I							
II	42	7483	5781	8781	4056	5996	5092
III	19	2066	1785	2411	1813	1695	2687
	61	9549	7566	11192	5869	7691	7779
Av.		156	123	183	96	126	127
Class III							
Plot I	1	95	68	140	50	30	25
II	19	2119	2308	4375	1840	2339	2012
III	12	1959	1663	2161	1405	1136	1177
	32	4173	4039	6676	3295	3505	3214
Av.		130	126	208	103	109	100
Class IV							
Plot I	18	2078	1776	3050	1126	370	129
II	11	1711	1484	2635	1203	1188	827
III	13	1752	1380	1904	1111	1216	920
	42	5541	4640	7589	3440	2774	1876
Av.		132	110	181	82	66	46
Class V							
Plot I	67	7144	5916	9669	4030	86	65
II	7	721	705	967	675	818	584
III	41	8413	6421	9006	4780	625	384
	115	16278	13042	19642	9485	1529	1033
Av.		141	113	171	83	13	9

Table No. 6

SUMMARY OF TOTAL AND AVERAGE ANNUAL GROWTH IN MILLIMETERS FOR EACH SAMPLE PLOT, 1921 TO 1926 INCLUSIVE

Plot I	No. Trees	1921	1922	1923	1924	1925	1926
Class I							
II							
III	1	95	68	140	50	30	25
IV	18	2078	1776	3050	1126	370	129
V	67	7144	5916	9669	4030	86	65
	86	9317	7760	12859	5206	486	219
Av.		108	90	150	60	6	2.5
Plot II							
Class I	17	1950	1561	3033	1089	1646	1604
II	42	7483	5781	8781	4056	5996	5092
III	19	2919	2308	4375	1840	2339	2012
IV	11	1711	1484	2635	1203	1188	827
V	7	721	705	967	675	818	584
	96	14784	11839	19791	8863	11987	10119
Av.		154	128	209	93	125	105
Plot III							
Class I	6	716	705	983	612	673	542
II	19	2066	1785	2411	1813	1695	2687
III	12	1959	1663	2161	1405	1136	1177
IV	13	1752	1380	1904	1111	1216	920
V	41	8413	6421	9006	4780	625	384
	91	14906	11954	16465	9721	5345	5710
Av.		164	131	181	107	59	63

Sample Strip Data - Northfork Burn

Selected sample strips were run July 13, 14 and 15, 1925. These strips were 2 chains wide; all trees on strip measuring 8 feet and over D.B.H. were tallied and also marked according to degree of fire injury.

The purpose of the sample strips was to obtain the basis for an estimate of the amount of timber in each class of fire injury for the entire burn and the per cent of survival in these classes. They were selected so as to include all types of burn, and were considered fairly representative of types as to area. The stand volume, however, was heavier for the strips than for the burn as a whole, and allowance has been made for this in the estimates.

Data from the strips have been worked up in the form of tables that do not entirely correspond to those from the sample plots. This seems desirable because of differing objects and methods in taking the records.

Strip No. 1

Location - Beginning at corner of sections 8,9,16 and 17, T 7 S, R 23 E, runs north 135 chains along line between Secs. 8,9 and 5,4 to a point 15 chains N of ¼ corner between Secs. 4 and 5; 2 chains wide; total area 270 sq. chains.

Dates of Examinations - July 13,14, 1925; surveyed and marked by H.L. Person. October 9, 1926, reexamined by J.M. Miller and M.W. Blackman.

Strip No. 2

Location - Beginning at corner of sections 8,9,18 and 17, T 7 S, R 23 E, runs E 24 chains on line between Secs. 9 and 16; 2 chains wide; total area 48 sq. chains.

Dates of Examinations - July 14, 1925; surveyed and marked by H.L. Person. October 8, 1926, reexamined by Miller and Person.

Strip No. 3

Location - beginning at blazed oak 20' south of the forks of Ellis Meadow and Hoag Ranch roads, runs due west 24 chains through NW¼ SW¼ of Sec. 16, T 7 S, R 23 E.

Dates of Examinations - July 15, 1925, surveyed and marked by H.L. Person. October 8, 1926, reexamined by Miller and Person.

Summary of Strip Surveys

Total length, 183 chains or 2.3 miles; average width, 2 chains

Total area, 366 square chains or 36.6 acres

Total acreage of burn, 5460 acres

Strip area, half of one per cent of total area

Total volume estimated for entire burn, 9,110 M.B.M.[1]

Estimated stand per acre for entire burn, 3500 B.F.

Total stand tallied on strips, 392,040

Average stand per acre on strips, 10,712

Stand volume on strips equals 1.3 per cent of total stand

Summary of Trees Marked on Sample Strips

Table No. 7

Number and Volume of Trees 12" and Over D.B.H.

Class	No. Trees	% of Total No. of Trees	Volume	Av. Volume per Tree	% of Total Volume
I	59	14.1	67,400	1140	17.2
II	119	28.3	173,770	1460	44.3
III	67	16.0	61,120	912	15.6
IV	72	17.1	57,200	795	14.6
V	61	14.5	19,780	324	5.1
VI	42	10.0	12,770	304	3.2
Total	420	100.0	392,040		100.0

[1] Based upon cruise estimates on file in Forest Supervisor's office at Northfork

Table No. 8

Number of Poles 8 to 10" D.B.H.

Class	No. of Trees	% of Total No.
I	21	11.8
II	36	20.3
III	18	10.2
IV	17	9.6
V	41	23.2
VI	44	29.9
Total	177	100.

The averages obtained from the strip surveys were used as a basis for estimates for the entire burn given inthe first section of the report. The total stand estimate for the burned area was divided into injury classes according to the per cent of stand of each class, or strips. The number of trees was determined by applying the average volume per tree for each fire class.

Insect Losses Subsequent to Fire

A check was made of all trees on the sample strips October 4-6, 1926; also trees that had died since the last marking were re-marked and given a serial number. All trees so marked were insect-killed.

Table No. 9

Insect Losses by Years

Class	Year Killed by Insects: 1924 No.Trs.	1924 Vol.	1925 No.Trs.	1925 Vol.	1926 No.Trs.	1926 Vol.	Total Trs.	Total Vol.
I								
II			5	2,750	2	570	7	3,320
III			14	9,400			14	9,400
IV	4	6,000	31	21,130	2	290	37	27,420
V	16	3,880	44	5,050			60	8,930
Totals	20	9,880	94	38,330	4	860	118	49,070

Table No. 10

Summary of Trees Attacked and Surviving on Sample Strips to October 1926

	No.Trs.	%
Killed by fire - Class VI	86	14.
" D. brevicomis	70	12.
" D. monticolae	2	.3
Attacked by other insects (flatheads, roundheads, D.valens; primary attack doubtful)	46	7.7
Surviving	393	66.
Total	597	100%

Summary by Volume

	No.Trs.	Volume	% by Vol.
Killed by fire	86	12,770	3.
" insects following fire	118	49,070	13.
Surviving	393	330,200	84.
Total	597	392,040	100%

Table No. 11

Percentage of Trees Attacked by Insects in Each Fire Class

	Cl. I	Class II			Class III			Class IV			Class V			Total
	80	155 Trees			85 Trees			89 Trees			102 Trees			511 Trs.
		1924	1925	1926	1924	1925	1926	1924	1925	1926	1924	1925	1926	
		Tr; %	Tr; %	Tr; %	Tr; %	Tr; %	Tr; %	Tr; %	Tr; %	Tr; %	Tr; %	Tr; %	Tr; %	Trs; %
Dendroctonus brevicomis			5; 3.5			10; 11.7			3; 3.3	9; 10.1		12; 11.7	15; 14.7	54; 10.6
F'head and Roundhead Borers				2; 1.2		3; 3.5			1; 1.1	13; 15.7	1; 1.1	1; .9	29; 23.7	45; 8.8
D. brevicomis and Borers Combined						1; 1.1				8; 8.9	1; 1.1	1; .9	5; 9.5	16; 3.1
Flatheads & D. valens									1; 1.1					1; .22
Dendroctonus monticolae												2; 1.96		2; .4
Totals for Class		7 Trees			14 Trees			37 Trees			60 Trees			118 Trs.
% of Class Attacked		4.5			16.3			42.4			74.5			21.1

Table No. 12

Survival of Trees, Including Poles,
In Each Class of Fire Injury on Sample Strips

Class	Trees Originally Marked		Attacked by Insects		Alive October, 1926		% of Survival	
	No. Trs.	Volume	Trs.	Volume	Trs.	Volume	Trs.	Volume
I	80	67,400			80	67,400	100.	100.
II	155	173,770	7	3,320	148	170,450	95.5	98.9
III	85	61,120	14	9,400	71	51,720	83.7	84.6
IV	72	57,200	37	27,420	35	29,780	57.6	52
V	102	19,780	60	8,930	42	10,850	41.1	54.8
VI	86	12,770	Fire-killed					

Effect of Fire Upon Growth
and Relation to Subsequent Insect Attack

In marking the trees a record was taken of the primary insect infestation at the base and of the amount of growth since the fire. The latter was made by chipping out the sapwood and examining the rings with a hand lens. Growth was checked as follows:

0 - No visible growth since fire
1 - Some evidence of growth but no perceptible rings; tree kept alive to 1925
2 - Perceptible growth; rings distinct; small 1925 ring
3 - Fairly good growth; good 1925 ring

Table No. 13

Relation of Growth Since Fire to Class of Fire Injury

Degree of Growth Since Fire	Class I Trs.	%	Class II Trs.	%	Class III Trs.	%	Class IV Trs.	%	Class V Trs.	%	Totals
0 Imperceptible					5	5.8	23	25.8	46	45	74
1 Slight			3	1.2	9	10.5	13	14.4	14	13.7	39
2 Fair			4	2.5			1	1.1			5
3 Vigorous											
			7		14		37		60		118

Table No. 14

Relation of Growth Since Fire to Species of Insect

Insect	0 Imperceptible Trees	%	1 Slight Trs.	%	2 Fair Trs.	%	3 Vigorous Trs.	%	Total Insect-Killed Trees Trees	%
D. brevicomis	31	26.3	19	16.1	4	3.4			54	45.8
F'head and R'head Borers	30	25.5	14	11.8	1	.8			45	38.1
D. brevicomis and Borers	11	9.3	5	4.3					16	13.6
D. valens and Borers			1	.8					1	.8
D. monticolae	2	1.7							2	1.7
	74	62.8	39	33.0	5	4.2			118	100.

Photo No. 1 - Southern part of Northfork burn from Shinn Ranch, showing drainage of Peckinpah Creek. This part of the area suffered heaviest fire damage. Photo shows openings made by fire and white topped beetle-infested trees in surviving stand. The upper line of the burn can be traced in this picture. Further north (to right of area shown here) the fire reached top of ridge. Photo by J.M.Miller, September 1925.

Photo No. 1

Photo No. 2 - Scar made by crown fire in NW¼ of Sec. 8, T 8 S, R 23 E. Area in center shows type IV burn. Negative was made with panchromatic plate so that beetle infested trees with fading and sorrel foliage show white in photo. Note how these trees extend around the borders of the type IV burn. Strip No. 3 runs across upper edge of this scar from top of ridge to point where photo was taken.

Photo by J.M.Miller, Sept. 1925.

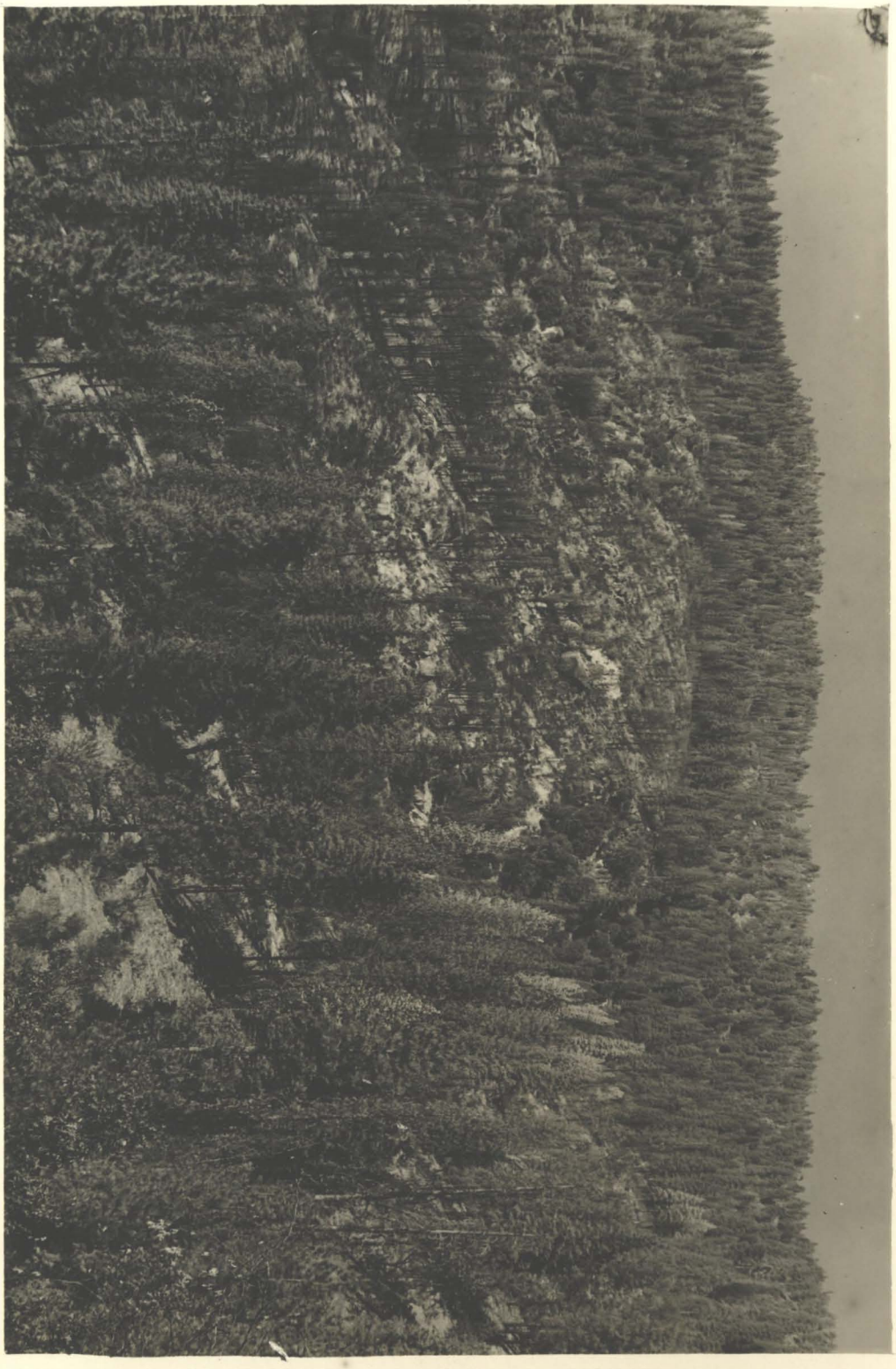


Photo No. 2

Photo No. 3 - A typical Type II burn in NE¼ of NE¼ of Sec. 16, T 8 S, R 23 E. Underbrush (manzanita) and lower limbs of oak killed by fire. Lower limbs of pine scorched so as to kill most of needles (note tree in center).

Outer bark has been blackened near base, but cambium is uninjured in most of these trees. Trees of this class show no retardation of growth, and very few were attacked by barkbeetles.

Photo by J.M. Miller, Oct. 1925.

Photo No. 3

Photo No. 4 - Type III burn in SE¼ SE¼ of Sec. 8, T 8 S, R 23 E. These trees, which were placed in fire injury Class V, were completely defoliated by the fire in 1924 but put out new needle growth in 1925; trees to which arrows point were attacked by western pine beetle during the summer of 1925.

Photo by J.M.Miller May, 1926.

Photo No. 4

Photo No. 5 - Type III burn on Sample Plot #1. These trees were all placed in fire injury Class V but put out new needle growth in 1925 without making a perceptible growth ring. Nearly all trees of this class on Plot 1 were killed by the western pine beetle.

Photo by J.M.Miller May 1926.

Photo No. 5

Photo No. 6 - Type IV burn on NE¼ of SE¼ of Sec. 17, T 8 S, R 23 E.
Practically all trees killed by fire and are in Class VI.
Only a small percent of these trees were attacked by the
western pine beetle but they were heavily infested by
flathead and round head borers.
Photo by J.M.Miller May 1926.

Photo No. 6

Photo No. 7 - A yellow pine of Class V showing pitch tubes of western pine beetle on surface of bark blackened by fire. Cambium was still alive at time of attack.
Photo by J.M.Miller May 1926.

Photo No. 7

Photo No. 8 - Section from tree No.69 (Class VI) Plot 1, which was killed by the fire and attacked by flathead borers. The angle cut across 1923 and 1924 rings at upper righthand corner was made in blazing tree at time plot was established. There is no healing callus about this scar. The width of 1924 ring represents growth made up to June 21, when fire occurred.
Enlarged photo by J.M. Miller, Oct. 1927.

Photo No. 9 - Section from tree No.48 (Class IV) Plot 1, showing healing callus over scar made in marking. Tree was blazed on surface of 1924 sapwood in August. No further growth was made in 1924 but distinct annual wood was formed about the scar in 1925 and 1926. However, annual rings were not discernible beyond the 1924 summer wood at any other point on the trunk. This tree was alive and had put out a full complement of 1925 and 1926 foliage when section was taken in October, 1926.
Enlarged photo by J.M. Miller, Oct. 1926.

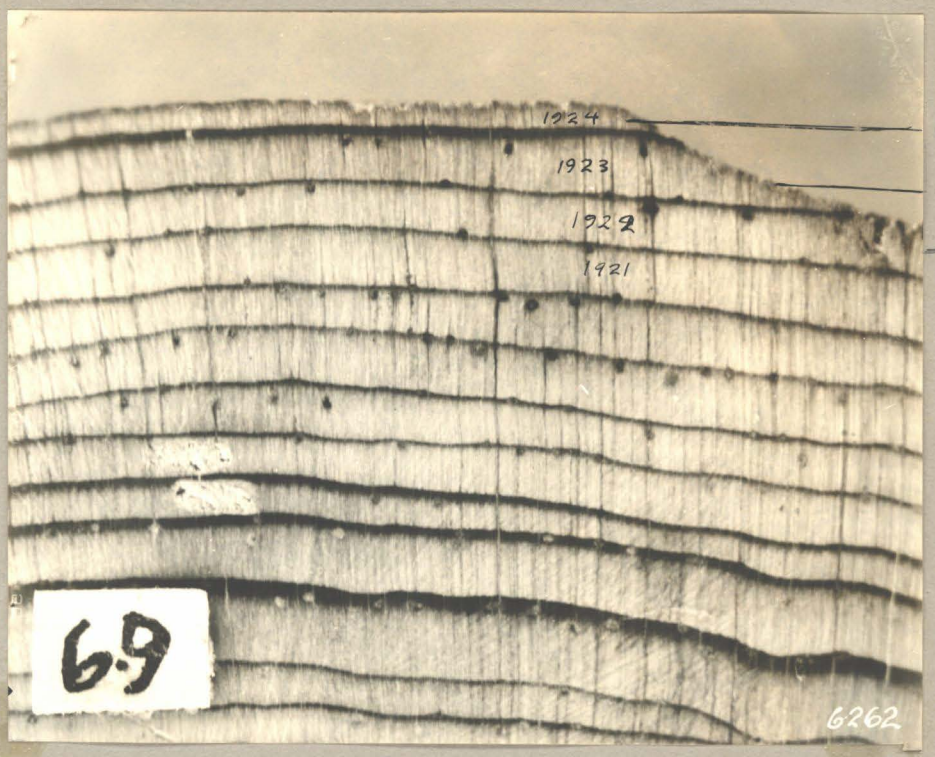


Photo No. 7

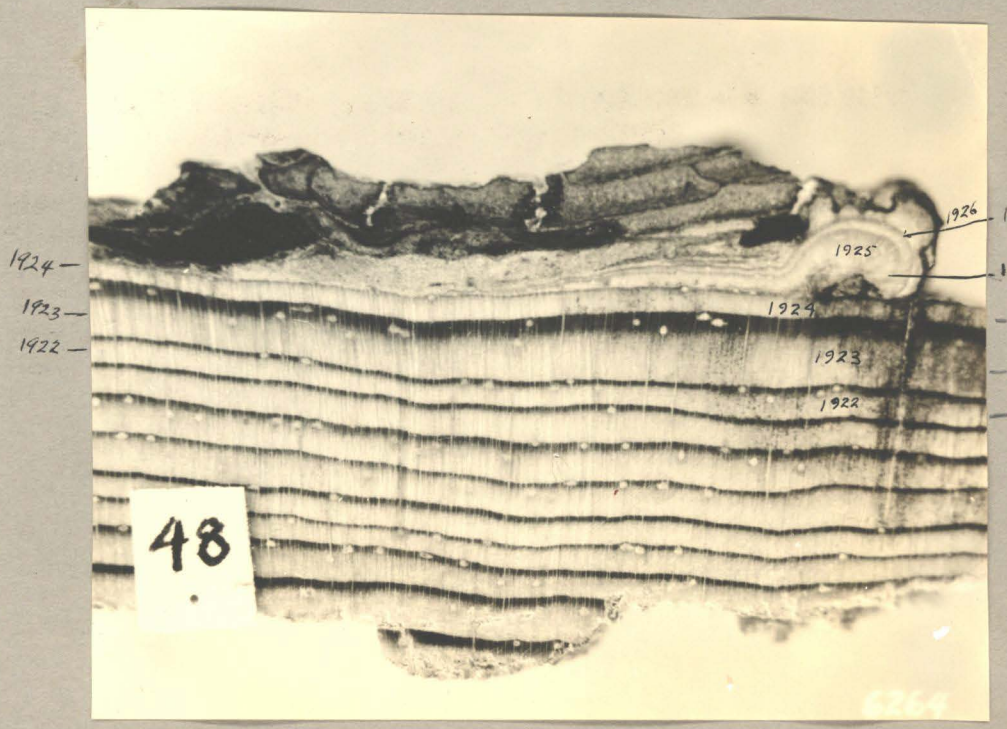


Photo No. 8

Photo No.10 - Section from tree No.18 (Class V), sample plot 1, showing healing callus over marking scar. This tree shows a similar laying on of wood about the scar in 1925 and 1926 as tree No.48. However, there is an apparent brokwn ring at other points on the trunk which has been put on either in 1925 or 1926.
Enlarged photo by J.M. Miller, Oct. 1926.

Photo No. 11 - Section from tree No. 22 (Class V), sample plot 1, showing healing callus and growth made since fire. The edge of the marking scar shows at left side of section. A slight growth was made in 1924 following the fire, and two barely perceptible layers of late wood were joined. A complete ring was formed in 1925, but with a much heavier layer of late than of summer wood. The 1926 ring is complete throughout, and although smaller than any rings preceding the fire shows a marked tendency toward recovery. This is a 12" tree and very fast-growing.
Enlarged photo by J.M. Miller, Oct. 1926.

Photo No. 10

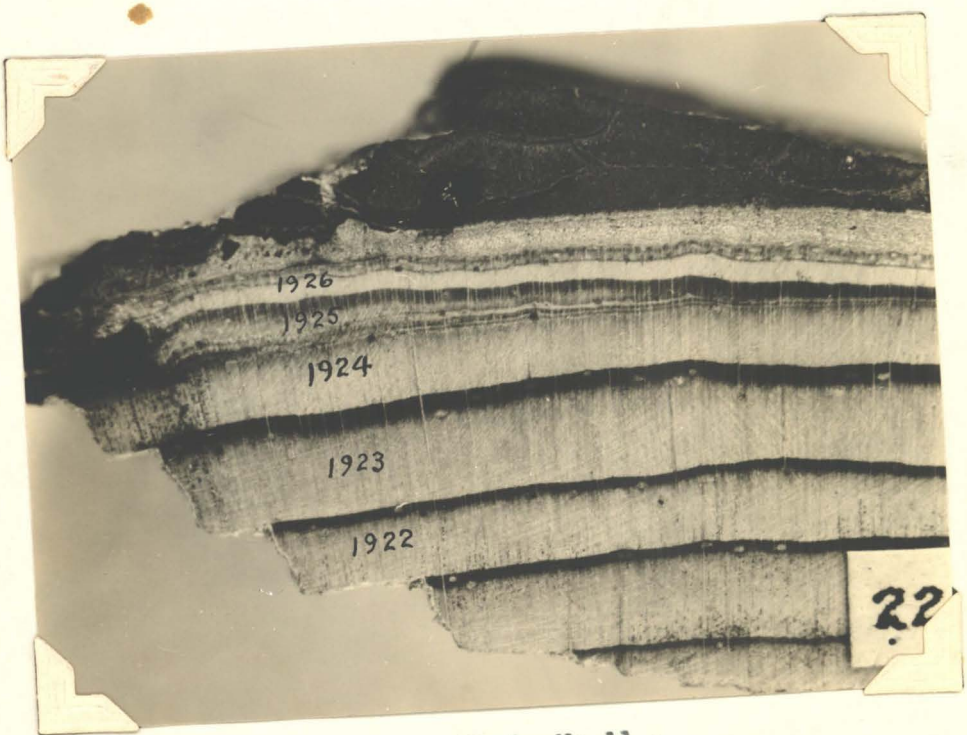


Photo No.11